5.2 Quadratic Models

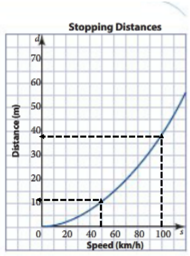
p.282- 293

Example 1 p.284
Reading Values of a Graph

Stopping Distances

The graph shows the stopping distance, in metres, and the speed of a car, in kilometres per hour.

a) Describe the relationship between stopping distance and speed.
b) Use the graph to estimate the stopping distance at 50 km/h and at 100 km/h.
c) If the speed doubles, does the stopping distance double? If not, describe the change in the stopping distance when the speed doubles.
d) Consider the rate of change of stopping distance with respect to speed. What are appropriate units for this rate of change?
e) Is the rate of change of stopping distance with respect to speed increasing, constant, or decreasing? Justify your answer.



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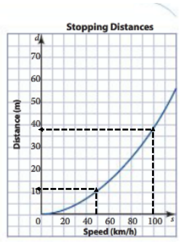
c) If the speed doubles, does the stopping distance double? If not, describe the change in the stopping distance when the speed doubles. x4
d) Consider the rate of change of stopping distance with respect to speed. What are appropriate units for this rate of change? x^2
e) Is the rate of change of stopping distance with respect to speed increasing, constant, or decreasing? Justify your answer.

Increasing



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ii) Graphing Quadratic Relationships

Example 2 using TI83 p. 285

Analyse a Free-Fall Ride

The table shows distance and time data for a free-fall ride at an amusement park.

Time (s)	Distance (m)
0.0	0.0
0.2	0.2
0.4	0.8
0.6	1.8
0.8	3.2
1.0	5.0
1.2	7.2
1.4	9.8
1.6	12.8
1.8	16.2
2.0	20.0
2.2	24.2
2.4	28.8
2.6	33.6

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2.4	28.8
2.6	33.6

Δy_1 $(y_2 - y_1)$ Δy^2

+0.2 0.4
+0.6 0.4
+1.0 0.4
+1.4 0.4
+1.8

Second Differences

Quadratic

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a) Does the Time column show equal time intervals?
b) Does the Distance column seem to model a linear relation? Explain your answer.
c) Calculate and record the first differences. Do the first differences imply an increasing, constant, or decreasing rate of change of distance with respect to time?
d) Calculate and record the second differences. Do the second differences imply a quadratic model? Explain why or why not.
e) Create a scatter plot with time on the horizontal axis and distance on the vertical axis. Does the graph imply a linear or non-linear relation? Explain.
f) Compare the table and the graph. Does the rate of change of distance with respect to time appear to be increasing, constant, or decreasing? Justify your answer.

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c)

		Δy^1	Δy^2
0	0		
0.2	0.2	0.2	
0.4	0.8	0.6	+0.4
0.6	1.8	1.0	0.4
0.8	3.2	1.4	0.4
1.0	5.0	1.8	0.4
1.2	7.2	2.2	0.4
1.4	9.8	2.6	0.4
1.6	12.8	3.0	0.4

NonLinear
Increasing

Quadratic

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iii, **Maximize Revenue**

Trevor sells hot dogs for $2.00 each from his cart at the beach. He currently sells an average of 120 hot dogs per day. If he increases the price, he will earn more per hot dog but may lose sales due to the increased price. He decides to gradually increase the price in steps of 10¢, and keep track of the effect on sales. Trevors' records are shown.

Price ($)	Average Daily Sales (hot dogs)	
2.00	120	240
2.10	117	245.7
2.20	114	250.80
2.30	111	255.30
2.40	108	259.20
2.50	105	262.50
2.60	102	265.20
2.70	99	267.30
2.80	96	
2.90	93	269.70
$\boxed{3.00}$	$\boxed{90}$	$270
3.10	87	269.70
3.20	84	
3.30	81	267.30

a) Calculate the average daily revenue from hot dog sales.

b) Calculate the first and second differences for the daily revenue. What do the first differences and the second differences tell you?

c) Use technology to fit a quadratic relation to the price and revenue data. What is the equation that models the data?

d) Determine if the revenue will continue to increase as the price increases or if it will reach a maximum and then decrease. If there is a maximum, determine the price that results in this maximum.

e) Suppose that Trevor decided to sell hot dogs at a special price of $1.50 to celebrate his birthday. Use the equation in part d) to determine the number of hot dogs he could expect to sell.

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a) Calculate the average daily revenue from hot dog sales.

b) Calculate the first and second differences for the daily revenue. What do the first differences and the second differences tell you?

c) Use technology to fit a quadratic relation to the price and revenue data. What is the equation that models the data?

d) Determine if the revenue will continue to increase as the price increases or if it will reach a maximum and then decrease. If there is a maximum, determine the price that results in this maximum.

e) Suppose that Trevor decided to sell hot dogs at a special price of $1.50 to celebrate his birthday. Use the equation in part d) to determine the number of hot dogs he could expect to sell.

Rev = Price × total sales

a) R = $2 × 120
= $240

2.00	$240		
2.10	$245.70	5.70	
2.20	250.80	5.10	−.60
2.30	255.30	4.50	−.60
2.40	259.20	3.90	−.60
2.50	262.50	3.30	−.60
2.60	265.20	2.70	−.60
2.70	267.30	2.10	−.60

At $3 he will reach a max revenue of $270.00.

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Key Concepts

- *If the first differences are not constant , the relation is non-linear*
- *Quadratic Relationship - second differences are constant*
- *Curve of Best Fit - used interpolate and extrapolate -predictions*

$x_1\ y_1$.

$$y_1 \sim a x_1^2 + b x_1 + c$$

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Hmk. p. 289 -293
q. 3,4,6 & 8

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